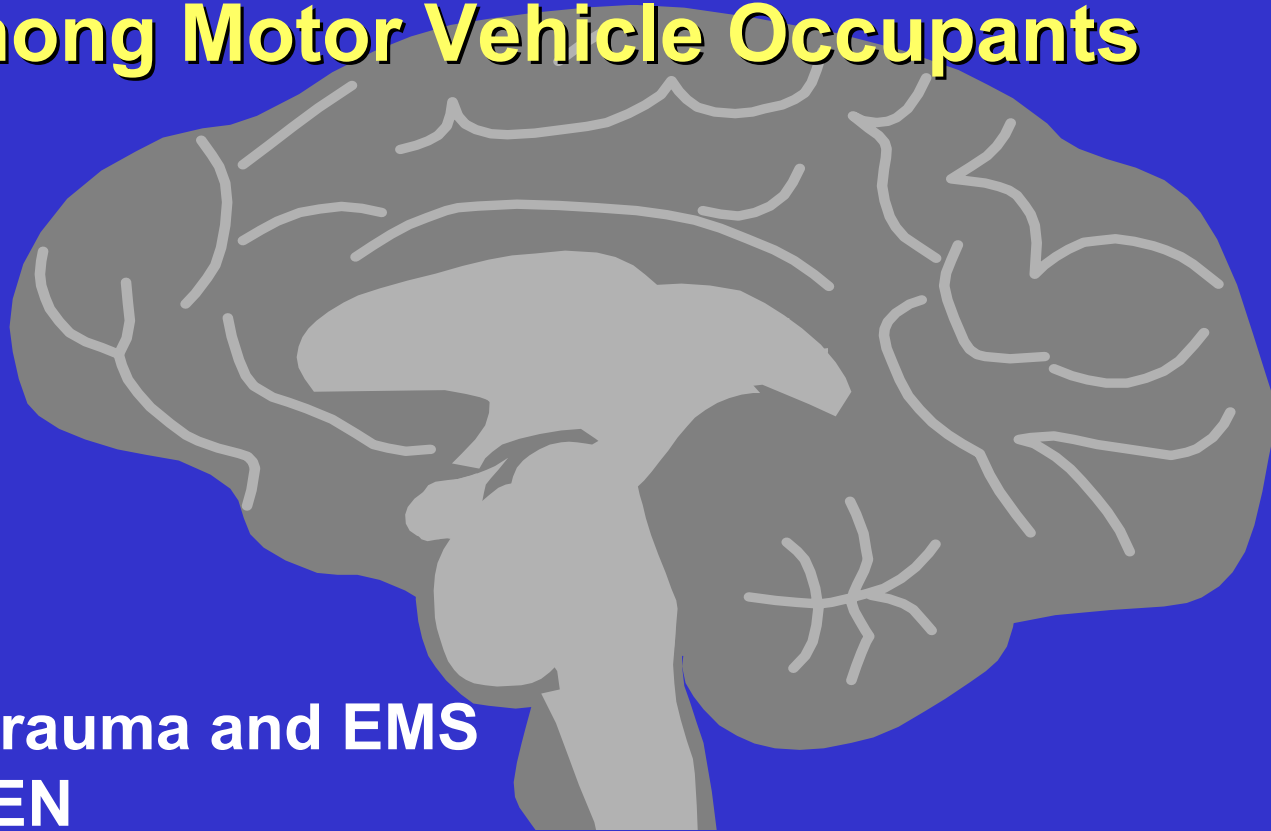


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# **Characteristics and Outcomes of Traumatic Brain Injury among Motor Vehicle Occupants**



**National Study Center for Trauma and EMS  
Maryland CIREN  
Baltimore, Maryland**

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# Maryland CODES Data

Police Crash  
Reports



Hospital  
Records



Drivers admitted to MD hospitals  
Passenger cars only  
1994-99 model year  
Calendar years 1997-1999



**N=2,664**

# Traumatic Brain Injury Definition

- **Definition of Brain Injury (CDC Criteria)**
  - Fracture of the vault or base of the skull
  - Other and unqualified and multiple fractures of the skull
  - Intracranial injury, including concussion, contusion, laceration, and hemorrhage
- **Serious brain injury:**
  - those with maximum AIS (MAIS) of 4 or 5

# Results

- 36.5% of hospitalized drivers had a TBI
- 10.5% of those had a head MAIS  $\geq 4$

# Incidence of TBI by Driver Characteristics

<u>Characteristics</u>	% with TBI	
	(%)	p
<b>Gender</b>		
Male	41	
Female	32	<0.001
<b>Age</b>		
<=19 Years	51	
20-39	39	
40-59	33	
60+	28	<0.001

# Incidence of TBI by Crash/Vehicle Characteristics

<u>Characteristics</u>	% with TBI	
	(%)	p
<b>“First Harmful Event”</b>		
Other Vehicle	32	
Parked/Fixed	43	
Overturn	48	<0.001
<b>Point of Impact</b>		
Frontal	34	
DS Lateral	38	
PS Lateral	44	
Rear	33	
Overturn	55	<0.001

# Incidence of TBI by Driver Characteristics

<u>Characteristics</u>	% with TBI	
	(%)	p
<b>Drinking/Drugged</b>		
Yes	46	<0.001
No	35	
<b>Belted</b>		
Yes	34	<0.001
No	48	

# Incidence and Severity of TBI Among Belted Drivers in Frontal Crashes

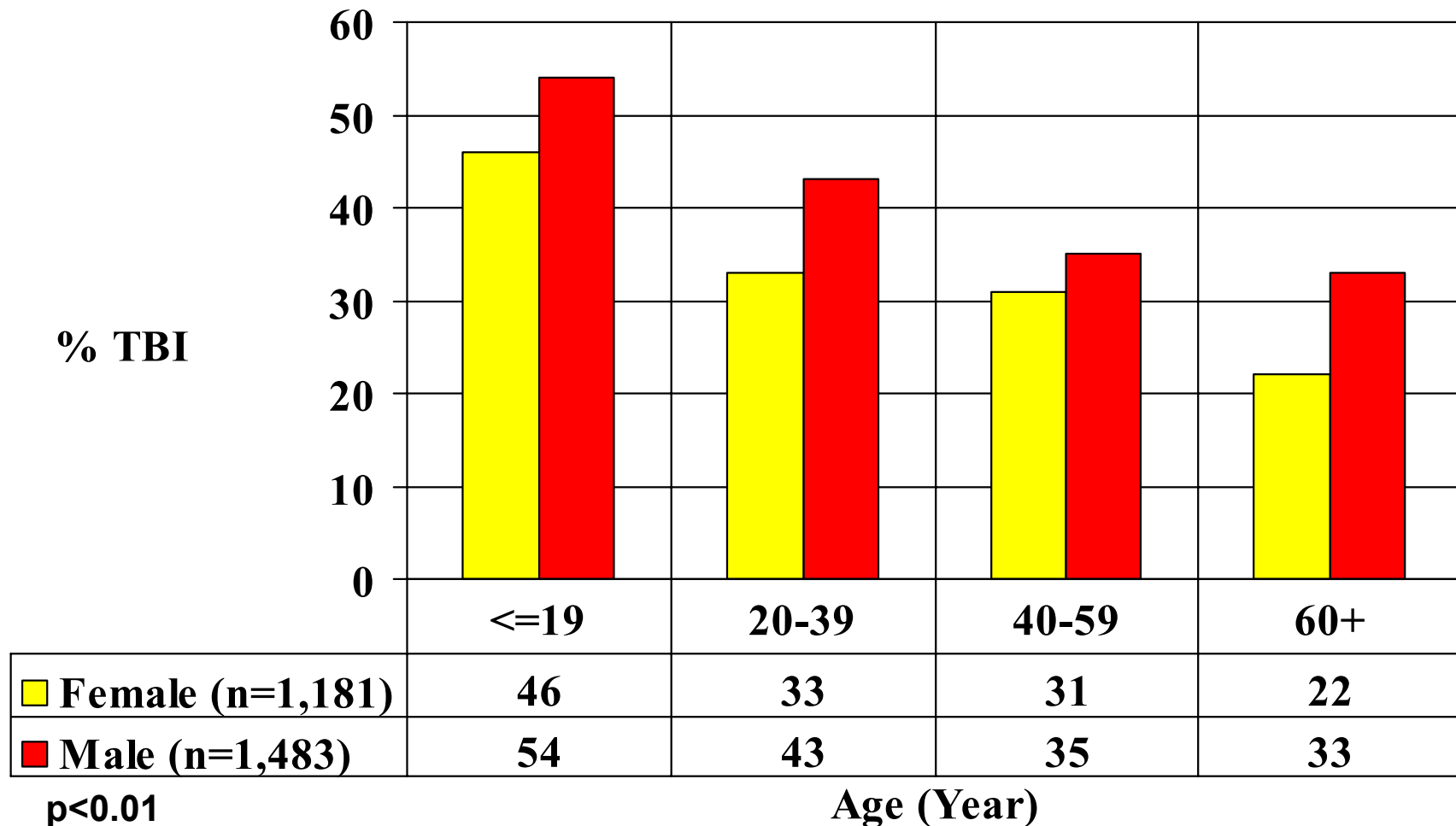
<u>Characteristics</u>	% with TBI (N=1,133)		p	% with Serious TBI (N=253)		p
	N	(%)		N	(%)	
<b>Airbag Deployed*</b>						
Yes	354	31		73	8	
No	779	30	NS	180	8	NS

\*Airbag deployment as recorded by PAR

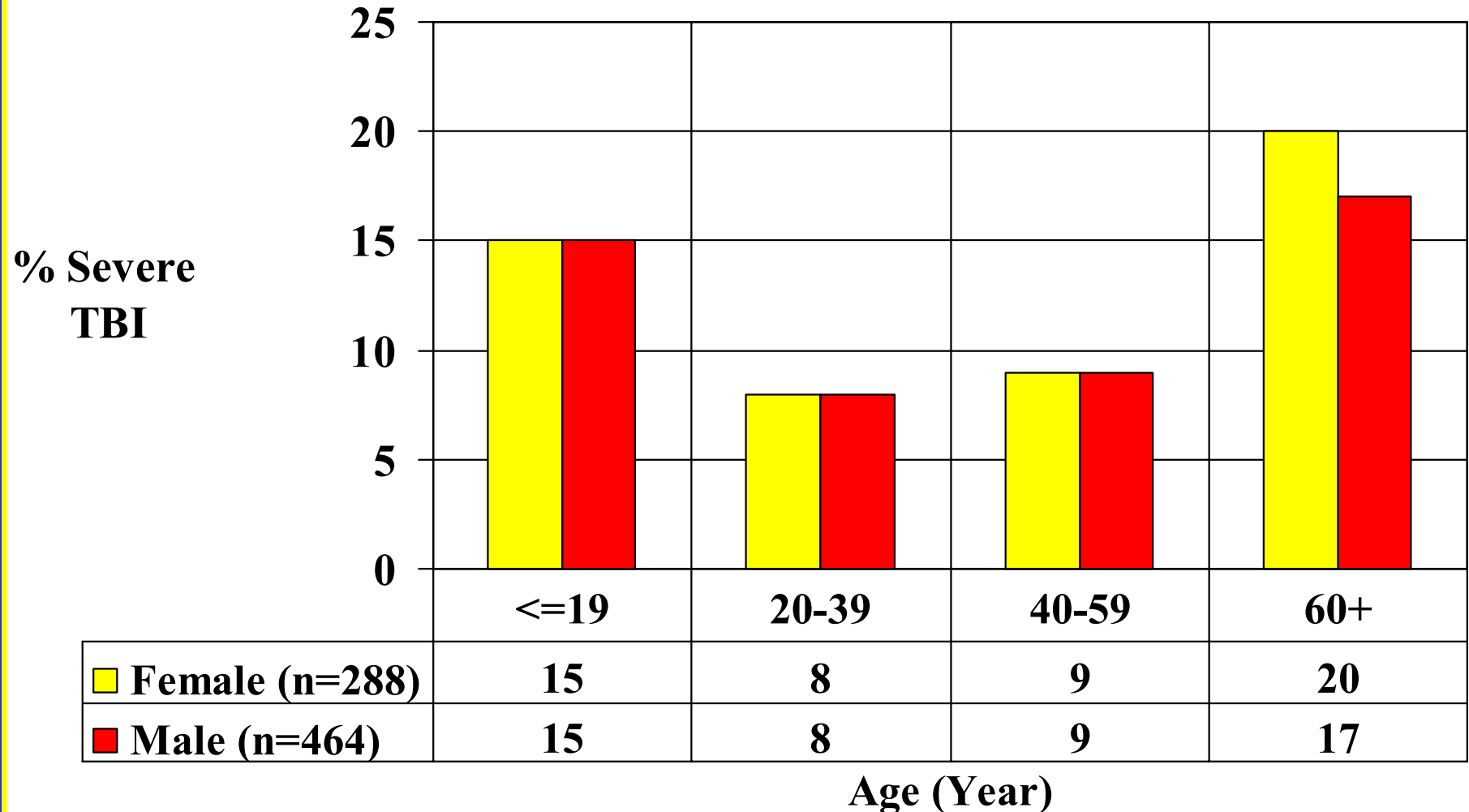


# Incidence of TBI By Age and Gender

(N=2,664)



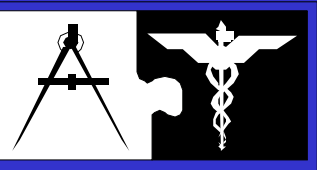
# Incidence of Severe TBI By Age and Gender (N=752)



# Distribution of Intracranial Injuries by Age Among Patients with TBI

<u>Injury Type</u>	Age<60 (n=851)		Age 60+ (n=122)		<u>p</u>
	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>	
Concussion	349	41.0	33	27.0	0.003
Cerebral lac/cont	45	5.3	11	9.0	NS
Subarachnoid hem	31	3.6	7	5.7	NS
Subdural hem	26	3.1	11	9.0	0.004
Other hemorrhage	20	2.4	7	5.7	0.07
Other unspecified intracranial injury	180	21.2	25	20.5	NS

**\*Among 973 brain-injured patients, 74.4% had intracranial injury.**



# CIREN Database

- 1,483 persons included as of 4/23/02
  - 1,228 (83%) with AIS score

0-19 years      24%

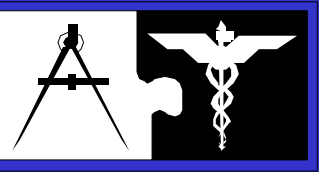
20-39 years    35%

40-59 years    23%

60+ years      17%

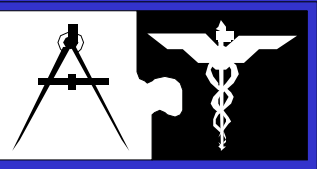
Men            49%

Women       51%



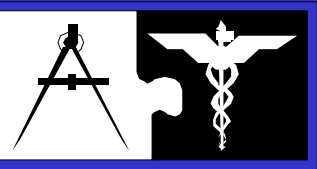
# CIREN Database

- 1,228 with AIS score
  - 537 persons (44%) with head AIS  $\geq 2$ 
    - Total of 1,007 individual injuries (34% AIS  $\geq 4$ )



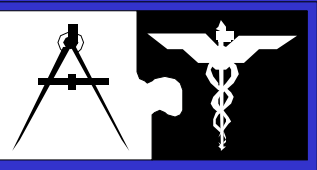
# CIREN Database

	<u>TBI</u>	<u>No TBI</u>	<u>p</u>
Median Age	30	35	NS
Median Delta V	41	36	0.03



# CIREN Database

<u>Characteristics</u>	<u>% with TBI (AIS&gt;1)</u> (%)	p
<b>Age</b>		
0-19	47	.05
20-29	49	
30-39	38	
40-49	44	
50-59	31	
60+	44	
<b>Gender</b>		
Men	47	<.05
Women	40	

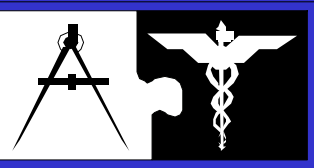


# CIREN Database

(Most common head injury by AIS codes)

- Unconsciousness <1 hour 17%
- Subarachnoid hemorrhage 13%
- Subdural hematoma (small) 4%
- Cerebral contusion (small) 4%
- Intraventricular hemorrhage 3%





# CIREN Database

QC complete and complete cases (n=497 cases)  
(Most common injury source for Head injury by AIS)

<u>Injury Source</u>	<u>AIS 4 (n=75)</u>	<u>AIS 5 (n=41)</u>	<u>AIS 6 (n=8)</u>
Other non-contact	14.7%	7.3%	75%
Airbag	6.7%	17.1%	0
Left side window/interior	8%	0%	-
Source unknown	8%	4.9%	-
Window, mirror, steering assembly	7%	15%	12.5%

# Conclusions

- Statewide data provides information on TBI:
  - Population based incidence
  - Risks by types of crash
  - Risks by driver characteristics
- CIREN provides crucial additional information:
  - Severity by GCS, Delta V, and PDOF
  - Mechanism of injury, contact points, validation of restraint use
  - Long-term outcomes not elsewhere available

# Traumatic Brain Injury Definition (CDC)

- **Mild Brain Injury**

- Head is struck or moves violently, resulting in a transient alteration of consciousness
- GCS 13 to 15
- No neurological deterioration
- Excludes skull fracture, intracranial hematomas and other pathology

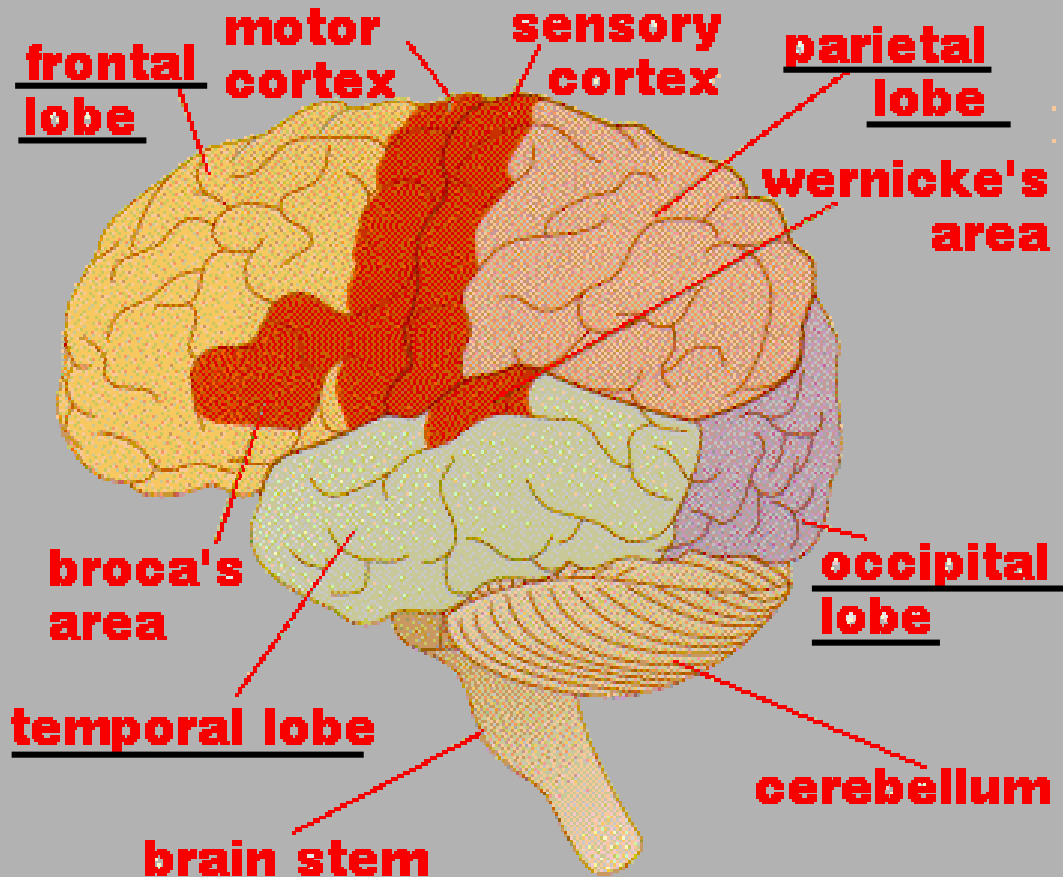
- **Serious brain injury:**

- Anatomic lesion substantiated by CT, autopsy, etc.
- Skull fractures
- Prolonged LOC
- GCS 12 and under

# Consequences of TBI

- **Emotional/Behavioral**
  - Depression, agitation, impulsiveness, mood swings
- **Physical**
  - Headaches, speech fluency, increased fatigue, balance
- **Cognitive**
  - Memory, impaired judgement, short attention span

# Brain Functions



- Frontal lobe
  - Emotional control
  - Social functioning
  - Expressive language
- Temporal lobe
  - Memory
  - Receptive language
  - Understanding of speech
- Parietal lobe
  - Academic skills
- Occipital lobe
  - Visual perception

# General Characteristics

MD CIREN patients with 1 year follow-up (n=90)

- Driver 92%
- Culpable 74%
- Restraint Use
  - AB+Belt 71%
  - AB Only 18%
  - Belt Only 9%
  - None 1%
- Point of impact
  - Frontal 84%
  - Lateral 13%
- Injuries
  - L. Extremity 72%
  - TBI 37%
- Median delta V 27 mph

# **Association of TBI and Delta V**

- Among patients with a TBI, 53% had a Delta V of 30 mph or less
- Regardless of TBI, 56% of patients with loss of consciousness were in a crash with a Delta V less than 30 mph
- Among serious TBI's (GCS 3-13), crash Delta V's were evenly distributed above and below the 30 mph threshold for frontal barrier standards

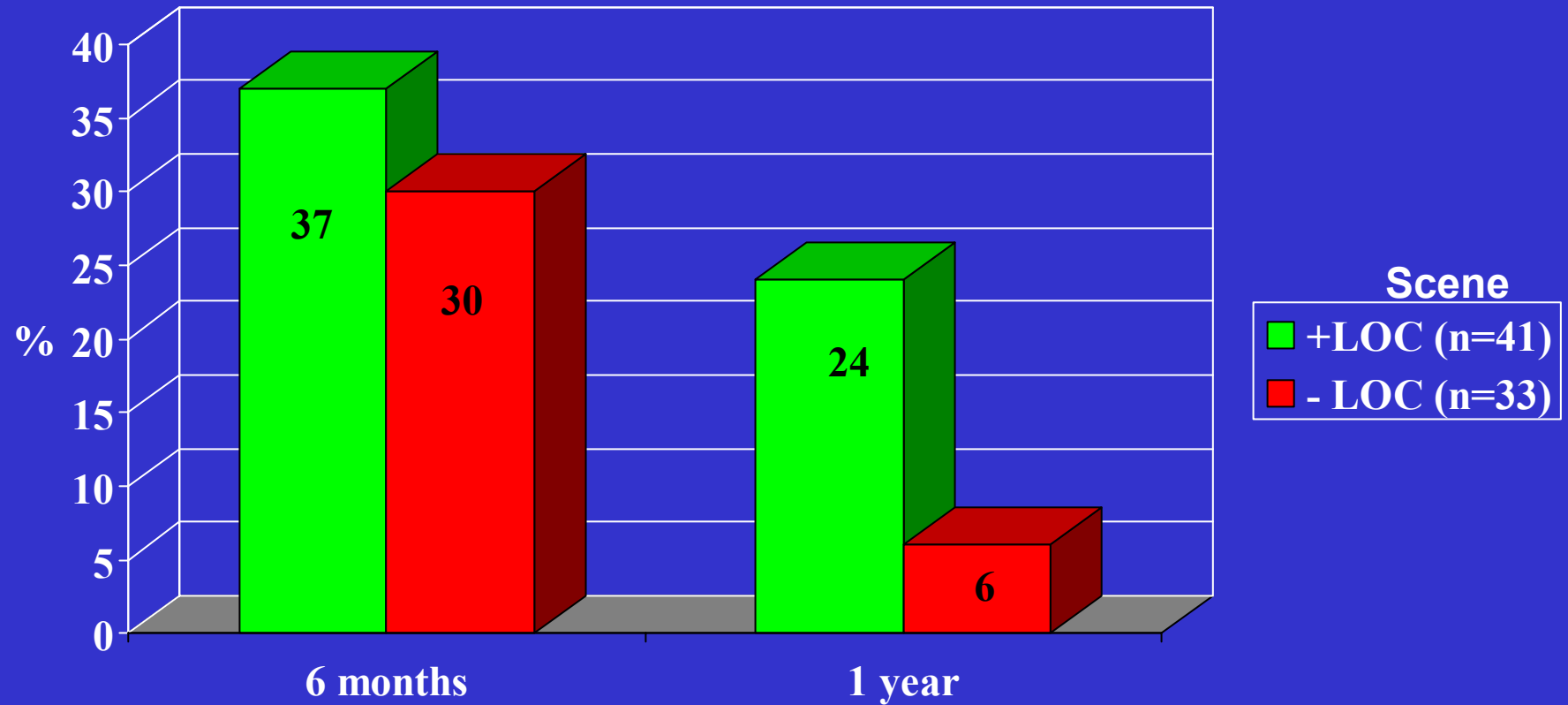
# *Outcome Similarities*

- Depression
  - Lost interest
  - Sleep disturbances
  - Altered mood
  - Cognitive concentration
  - Behavioral changes
- PTSD
  - Re-experiencing event
  - Sleep disturbances/fatigue
  - Limited affect
  - Cognitive-memory
  - Hypervigilance
- Post concussion
  - Sleep disturbances
  - Behavioral changes
  - Cognitive recall
  - Headache/dizziness



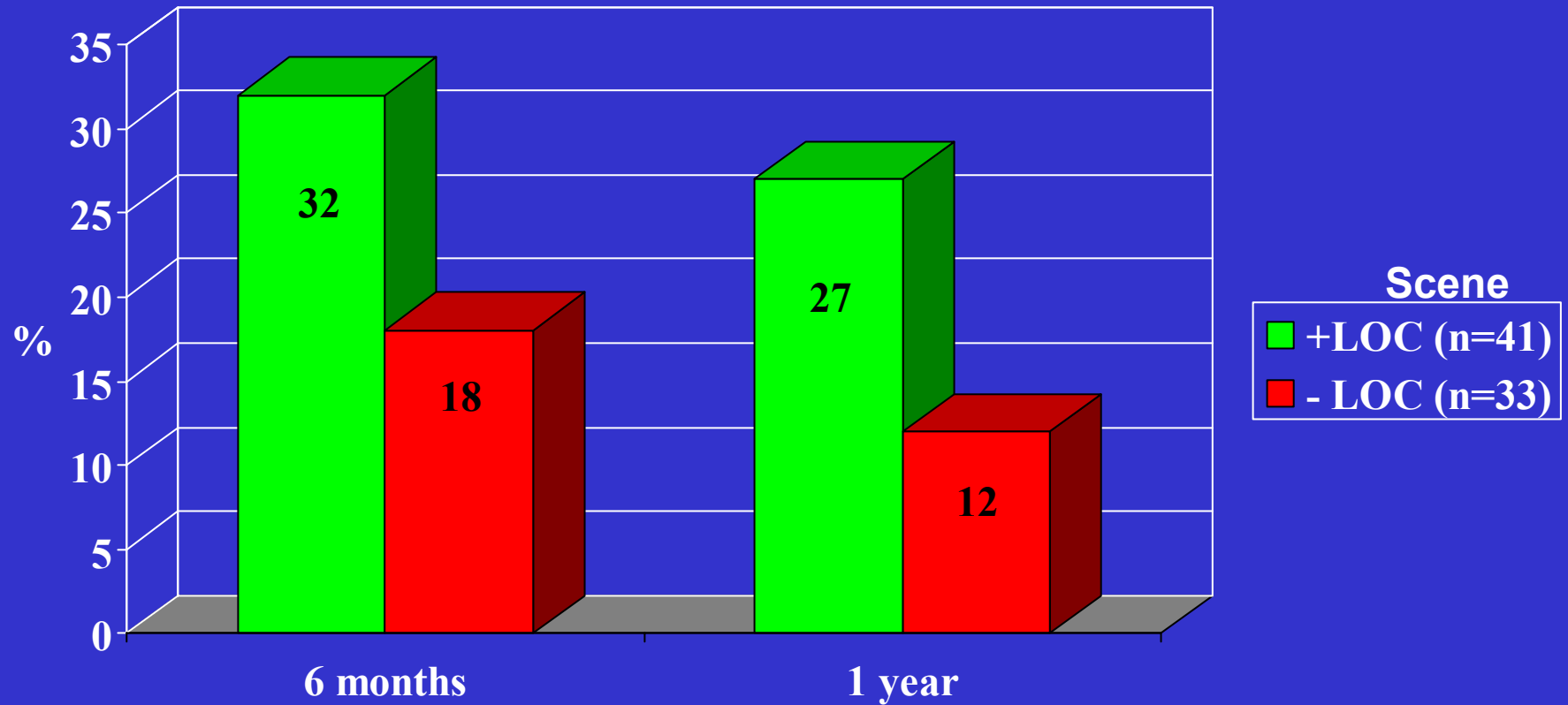
# Behavioral Change

(admission GCS=15)



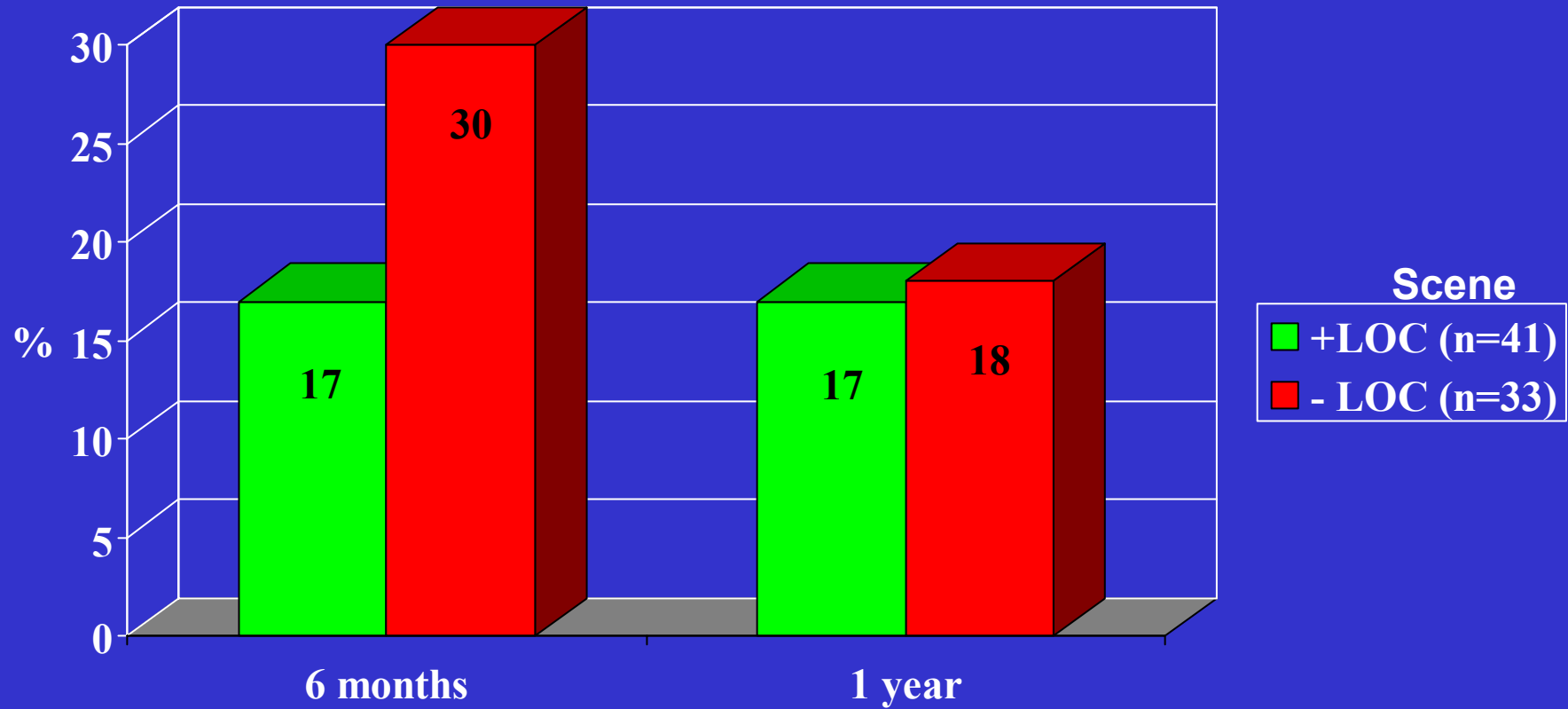
# Cognitive Problems

(admission GCS=15)



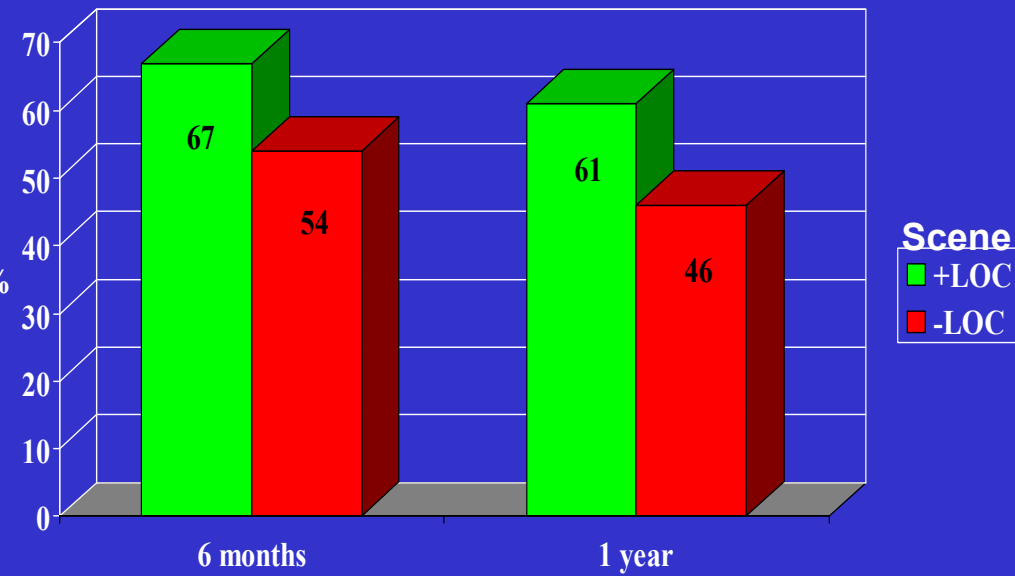
# PTSD

(admission GCS=15)

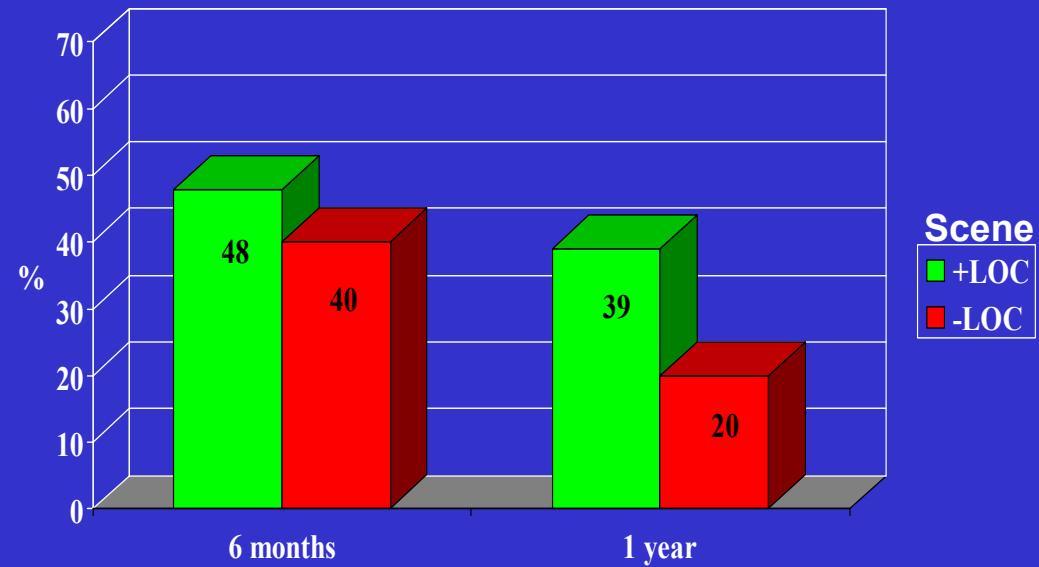


# Depression

(admission GCS=15)

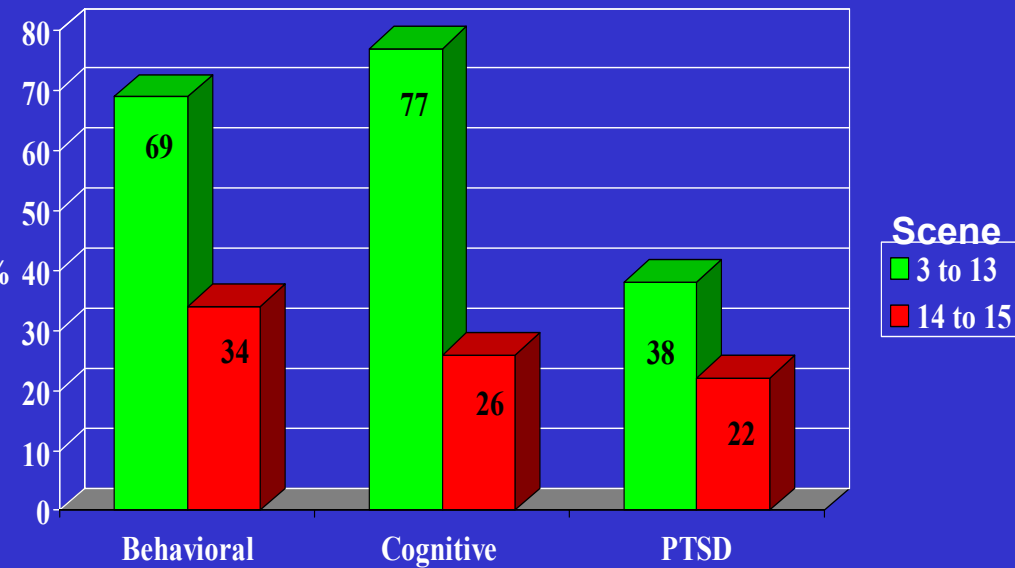


**Pre-injury Depression**

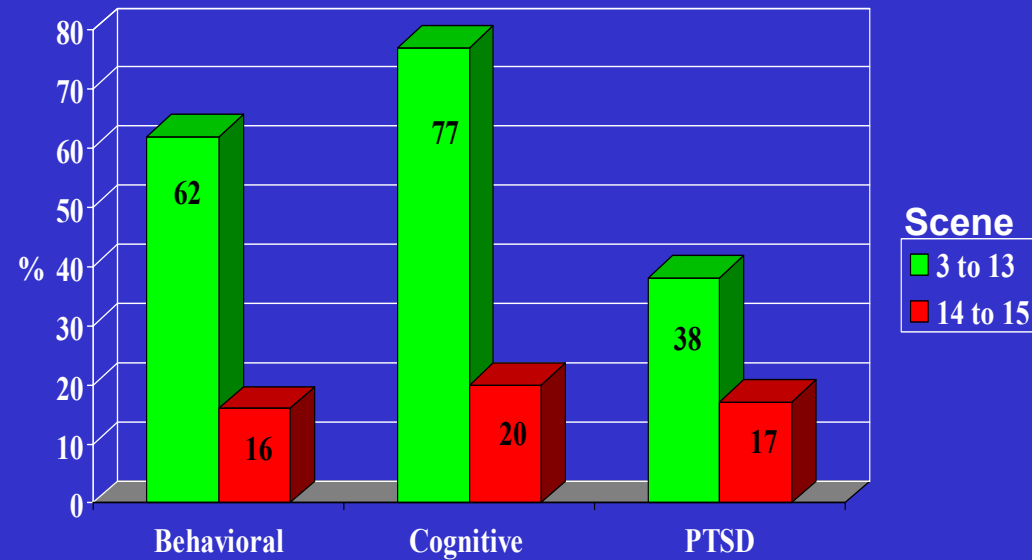


**No pre-injury depression**

# Admission GCS and Outcome



**6 months**



**1 year**

?Questions?